REFERENCE SAMPLE PROGRAM

METHOD OF TEST FOR DETERMINING THEORETICAL MAXIMUM SPECIFIC GRAVITY AND DENSITY OF HOT MIX ASPHALT

2016 PROFICIENCY TEST RESULTS

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1.0 OVERVIEW

Mid October 2016, the Caltrans Reference Sample Program (RSP) sent out announcements inviting laboratories currently enrolled in the Caltrans RSP to participate in proficiency testing. Laboratory proficiency testing is a requisite in the Caltrans Independent Assurance (IA) Program and is mandated by FHWA. Additionally, proficiency testing ensures that laboratories conducting tests on roadway materials for California Department of Transportation and Federally funded projects are qualified. This round of proficiency testing was based on, California Test (CT) 309, "Method of Test for Determining Theoretical Maximum (RICE) Specific Gravity and Density of Hot Mix Asphalt."

CT 309 test determines values for percent of air void in compacted Hot Mix Asphalt (HMA), established target values for compacting HMA and determines sufficient amount of binder absorbed by the individual aggregate particles in HMA.

Proficiency samples for CT 309 were prepared in the Reference Sample Laboratory located at 5900 Folsom Blvd, Sacramento, CA. The samples were prepared in accordance with CT 304 "Method for Preparation of Hot Mix Asphalt for Test Specimens" were obtained from a single source to minimize variability. The sample mass was approximately 2000 grams based on ¾-inch nominal maximum aggregate size, of the mix. The asphalt content of the mix was 5%.

The purpose of proficiency testing is to ensure that laboratories performing CT 309 are performing the test in accordance to the prescribed test method.

A total of 193 laboratories participated in the proficiency testing which included state and local agencies and private laboratories.

2.0 ANALYSIS OF TEST RESULTS

2.1 EVALUATION CRITERIA TEST

Test results were analyzed using a statistical evaluation system in which the mean (X) and standard deviation(s) were calculated. A rating score was then applied to the test results based on the criteria shown in Table 1. A test result with a score of 3 or greater was considered an acceptable result. A test result with a score of 2 or less was considered unacceptable and a retest was required.

Table 1: Evaluation Criteria

Test Result	Rating	Interpretation of Results	Acceptance
X ± 1.0s	5	Very Good	Acceptable
X ± 1.5s	4	Good	
X ± 2.0s	3	Fair	
X ± 2.5s	2	Poor	Unacceptable
X ± 3.0s	1	Very Poor	

2.2 INITIAL TEST

A total of 193 laboratories participated in the initial test. Analysis for outliers was performed in accordance with ASTM E 178 "Standard Practice for Dealing with Outlying Observation."

Table 2 summarizes the initial test results with outliers. Table 2A provides the statistical analysis and the scores obtained by laboratories with the corresponding percentages with respect for each rating. Outliers are were excluded from the analysis in Table 2A. The deadline for the initial test results was December 2, 2016. Detailed initial test results are provided in Appendix A.

Table 2: CT 309 Initial Test Results

CT 309				
Item	# of Laboratories	Initial Failures		Passing Laboratories Count
		Failure Count (Lab ID)	Outlier Count (Lab ID)	
CT 309	193	6 (10, 75, 84, 394, 412, 538)	4 (62, 110, 164, 501)	183

Table 2A: CT 309 Initial Statistical Analysis of Test Results

Item	# of Labs	Ave.	# of Outliers	# of Laboratories (used in analysis)	Number of Labs Achieved Score of				
					5	4	3	2	1
CT 309	193	2.554	4	189	131	35	17	3	3
				% of Total	69%	19%	9%	1.5%	1.5%

2.3 RETEST

10 laboratories did not receive acceptable scores during the initial test. Of the 10 laboratories, 4 submitted results considered as outliers. The week of January 13, 2017 re-test samples were sent to the respective laboratories in order to identify and correct deficiencies. All laboratories received acceptable scores during the retest. The re-test results were evaluated based on the initial statistical analysis results. Table 4 is a summary of re-test results. Detailed re-test results are provided in Appendix B.

Table 3: CT 309 Re-Test Results

CT 309 (Re-test)				
Item	# of Laboratories	Failures		Passing Laboratories Count
		Failure Count (Lab ID)	Missing Data (Lab ID)	
CTM 309	10	-	-	10

Table 3A: CT 309 Statistical Analysis of Re-Test Results

Item	# of Labs	Ave.	# of Failures	# of Laboratories (passed)	Number of Labs Achieved Score of				
					5	4	3	2	1
CT 309	10	2.554	0	10	8	1	1	0	0
				% of Total	80%	10%	10%	0%	0%

2.4 COMBINED TEST RESULTS

Table 4: CT 309 Combined Test Results

CT 309 (Combined)				
Item	# of Laboratories	Failures		Passing Laboratories Count
		Failure Count (Lab ID)	Missing Data (Lab ID)	
CT 309	193	-	-	193

Table 4A: CT 309 Statistical Analysis of Combined Test Results

Item	# of Laboratories	# of Failures	# of Laboratories (passed)	Number of Labs Achieved Score of				
				5	4	3	2	1
CTM 309	193	-	193	139	36	18	0	0
			% of Total	72%	19%	9%	0%	0%

3.0 OBSERVATIONS

There were 10 laboratories that failed the initial test. A retest was conducted by these 10 laboratories and each achieved acceptable results. The following observation was noted during the initial test results analysis.

- Tester Error – based on initial observation some of the testers recorded the sample size incorrectly, which affected results.

- Arithmetic and round - off errors. It was observed that some laboratories rounded up their values incorrectly. Other laboratories performed incorrect calculations.

4.0 SUMMARY

193 laboratories participated in the proficiency testing for CT 309. 183 laboratories received acceptable scores which constitutes a 95% passing rate. 10 laboratories received unacceptable scores and were required to retest. Of the 10 laboratories retested, all received acceptable scores. Since all laboratories passed the re-test the need for a 2nd retest accompanied with Caltrans I.A. Staff was not necessary.

5.0 REFERENCES

California Test Method 309, "Method of Test for Determining Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"

ASTM, "Standard Practice for Dealing with Outlying Observations," Designation E 178 – 80.

Caltrans, "Independent Assurance Manual," Sacramento, July 2005.

Appendix – A
CT 309 - INITIAL TEST RESULTS

CT ID#	Results G_{mm}	Score
1	2.554	5
2	2.537	3
5	2.550	5
6	2.559	5
7	2.530	3
8	2.551	5
***10**	***2.526**	***2**
11	2.545	5
12	2.548	5
16	2.567	5
23	2.537	4
24	2.551	5
28	2.572	4
29	2.571	4
32	2.555	5
34	2.576	3
38	2.549	5
40	2.545	5
42	2.572	4
43	2.531	3
46	2.551	5
47	2.566	5
49	2.571	4
52	2.544	5
53	2.539	4
56	2.542	5
57	2.547	5
58	2.573	4
59	2.540	4
62	2.399	O
63	2.552	5
64	2.548	5
65	2.546	5
66	2.572	4
67	2.552	5
68	2.553	5

CT ID#	Results G_{mm}	Score
69	2.556	5
70	2.538	4
71	2.561	5
73	2.556	5
74	2.555	5
***75**	***2.590**	***1**
76	2.573	4
79	2.558	5
***84**	***2.523**	***2**
87	2.561	5
88	2.534	3
93	2.552	5
94	2.557	5
99	2.549	5
102	2.560	5
104	2.546	5
110	2.399	O
112	2.567	5
118	2.550	5
120	2.568	4
122	2.538	4
123	2.572	4
125	2.543	5
131	2.556	5
135	2.551	5
139	2.554	5
140	2.564	5
141	2.552	5
143	2.551	5
144	2.559	5
145	2.555	5
146	2.576	3
147	2.536	4
151	2.566	5
154	2.545	5
155	2.562	5

LEGEND:
*** – FAILURE**
RED - OUTLIER

CT ID#	Results G_{mm}	Score
156	2.542	4
160	2.551	5
161	2.554	5
164	0.622	O
173	2.554	5
177	2.541	5
182	2.545	5
183	2.563	5
184	2.550	5
191	2.528	3
192	2.546	5
193	2.561	5
195	2.574	3
206	2.557	5
207	2.551	5
209	2.549	5
210	2.550	5
213	2.547	5
214	2.557	5
223	2.571	4
233	2.557	5
234	2.538	4
241	2.549	5
244	2.550	5
248	2.567	5
249	2.558	5
252	2.564	5
253	2.548	5
256	2.564	5
257	2.557	5
263	2.545	5
264	2.556	5
265	2.565	5
266	2.572	4
273	2.542	5
283	2.559	5
284	2.537	4
290	2.578	3
293	2.546	5

CT ID#	Results G_{mm}	Score
297	2.574	3
300	2.552	5
303	2.564	5
309	2.553	5
316	2.553	5
317	2.556	5
318	2.558	5
329	2.537	4
332	2.543	5
334	2.548	5
344	2.565	5
348	2.569	4
353	2.547	5
356	2.557	5
359	2.549	5
360	2.557	5
361	2.555	5
362	2.545	5
364	2.553	5
377	2.553	5
378	2.538	4
379	2.565	5
381	2.540	4
382	2.533	3
384	2.568	4
393	2.561	5
***394**	***2.602**	***1**
395	2.540	4
396	2.571	4
405	2.529	3
407	2.564	5
***412**	***2.592**	***1**
413	2.553	5
417	2.55	5
418	2.554	5
419	2.561	5
422	2.547	5
423	2.557	5
428	2.561	5

LEGEND:
*** – FAILURE**
RED - OUTLIER

CT ID#	Results G_{mm}	Score
430	2.558	5
437	2.570	4
438	2.562	5
441	2.556	5
443	2.543	5
454	2.562	5
457	2.556	5
464	2.553	5
482	2.563	5
483	2.551	5
485	2.554	5
493	2.534	4
495	2.532	3
501	2.753	O
508	2.543	5
513	2.572	4
521	2.559	5
534	2.548	5
535	2.561	5
***538**	**2.586**	**2**
543	2.537	4
551	2.532	3

CT ID#	Results G_{mm}	Score
552	2.564	5
565	2.537	4
569	2.575	3
574	2.572	4
576	2.560	5
580	2.533	3
600	2.535	4
608	2.556	5
609	2.567	4
612	2.565	5
627	2.547	5
630	2.53	3
635	2.549	5
636	2.552	5
643	2.560	5
644	2.553	5
647	2.566	5
649	2.552	5
650	2.562	5
655	2.566	5
656	2.553	5

Appendix – B

CT 309 – RE-TEST RESULTS

CT ID#	Results G_{mm}	Score
10	2.556	5
62	2.534	3
75	2.562	5
84	2.557	5
110	2.559	5
164	2.565	5
394	2.567	5
412	2.543	5
501	2.546	5
538	2.536	4

LEGEND:
*** – FAILURE**
RED - OUTLIER